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NOTES ON THE BIOLOGY OF *ANDRENA* (*CALLANDRENA*) *HELIANTHI* ROBERTSON (HYMENOPTERA: ANDRENIDAE)

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The nesting habits of andrenid bees, one of the largest groups of North American aculeates, are poorly known (Hurd, 1979). Perhaps their exclusive habit of nesting in the ground is partly responsible for this paucity of knowledge. The 52 U.S. species of *Callandrena,* a Nearctic subgenus of *Andrena,* exemplify this dearth of biological information; the nest of only one, *Andrena accepta* Viereck, has been described (Rozen, 1973). A brief description of nest digging, however, has been reported by Hicks (1926) for *Andrena helianthi* Robertson, the subject of this study. For the past four years, our laboratory has conducted studies of sunflower pollination, and during this time a sizeable adult population of *A. helianthi* has been observed. In the summer of 1979, many nests of this sunflower bee were found in our plots, and we were able to observe various aspects of its biology, including pollen collection, nest architecture, larvae, nest associates, and seasonal occurrence.

Nesting Site

Adult females were found nesting between irrigation furrows in plots planted to sunflower near Logan, Utah, and observations were made during July and August 1979. The one-acre plot where the bees nested was nearly flat, and the soil type was Millville Silt Loam. When *Andrena* nests were discovered during the course of the pollination studies, they were marked by a stake, and in September four of them were excavated. The number of nests found was not recorded, but there were at least ten. They were scattered among the rows of sunflower, and the nest entrances were usually near sunflower stalks. Although nest entrances were usually a meter or more apart, some were within a few centimeters of one another.

Nest Architecture

Entrance hole.—We were unable to observe bees starting to dig their nests, but, instead, we located bees entering established nests or found newly made tumuli. The oval tumulus surmounting a typical nest excavation measured 7 cm across and 1.5 cm high. Tumuli did not develop around the entrances of a few nests that were made under soil clods (Fig. 1) on the sloping side of irrigation furrows. Most nest entrances opened to the south and averaged 8 mm wide. A turret constructed in the side of the tumulus acted as a nearly horizontal passageway leading from the actual tunnel entrance to the edge of the tumulus (Fig. 2).

Burrows.—When the nests were excavated, the main burrow was plugged at intervals, but the lateral burrows were so completely packed with soil that they could not be traced. The main burrow of a typical nest was 8 mm wide, horizontal and plugged for 3 cm before it became vertical (for 10 cm) and again horizontal and plugged (for 2–3 cm). Beyond the second plug, the main burrow descended nearly vertically (for 5 cm), and then it was plugged again (for 1 cm). Finally, it sloped downward for another 24 cm, from which point the lateral branches were presumed to diverge (Fig. 3A). The main burrow ranged in depth from 30 to 37 cm. It was unlined, but had smooth walls. The distance from the main burrow to its associated cells ranged from 5 to 19 cm. In most nests, these cells were clustered, an indication that only 1 or 2 lateral burrows had been constructed (Fig. 3B).

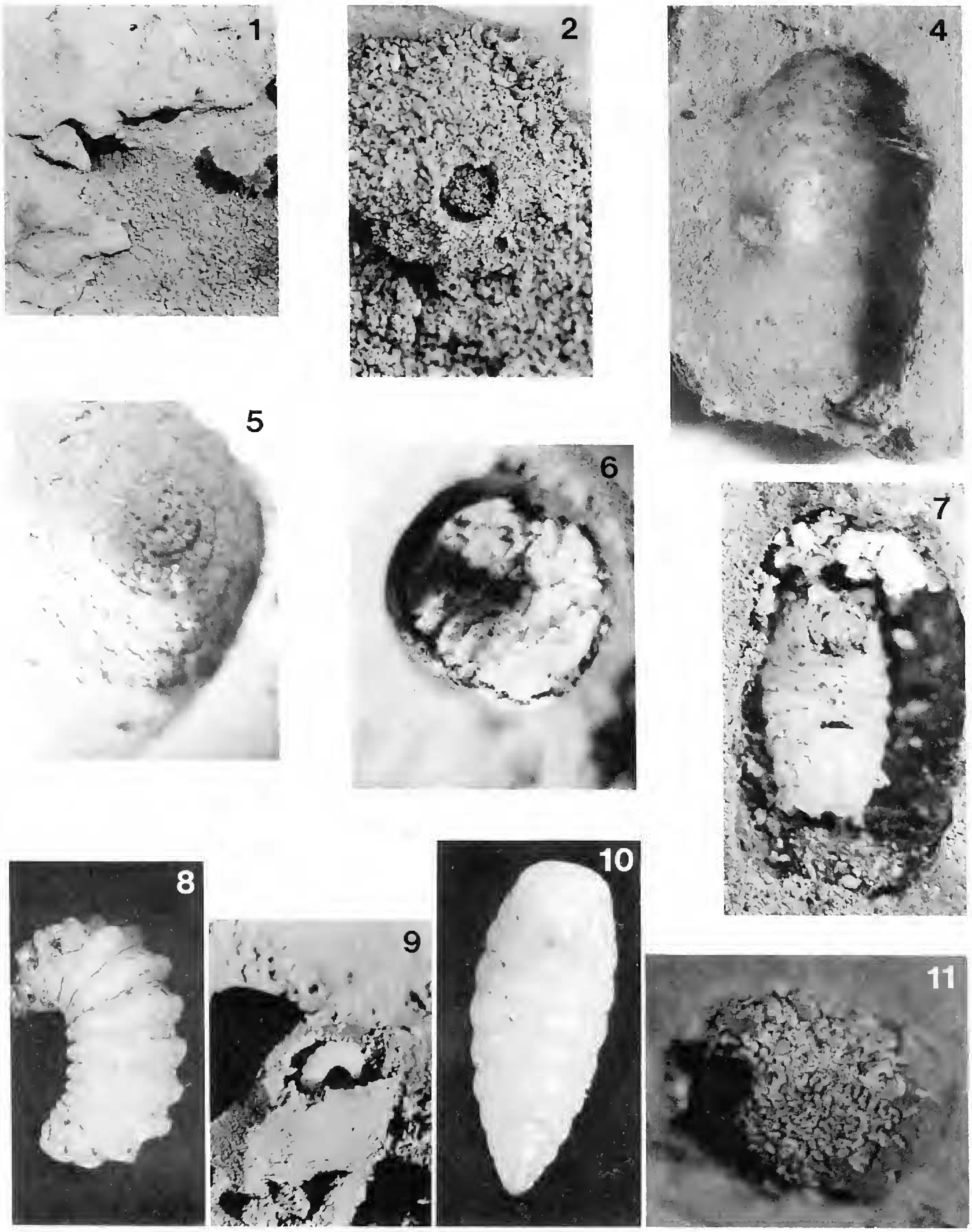
Cells.—Cells were found at depths ranging from 37 to 45.5 cm. In most nests, they were in short series (1–3) and were separated by about one cm of tightly packed soil. Some cell series within a few centimeters of each other were probably connected to the same lateral burrow. The number of cells/nest ranged from 1 to 8 and averaged 4.2. The oval cells were horizontal and ranged in inner width from 7 to 9 mm and length from 15 to 20 mm. The bees constructed the cell walls by compacting about 2 mm of soil against the roughed-out excavations and then coating the basal ⅔ of the smooth cell walls with a thin, brownish layer of wax (Fig. 4). The cell was narrower at the neck region (7 mm) than at the base (9 mm). It was capped by a clockwise spiral of 1.5 mm wide rings of soil. From the margin to the center were 5 rings, each slightly farther than its predecessor from the base of the cell, thus producing a domed cap (Fig. 5). The position and shape of the pollen-nectar provisions were not observable since in all cells the provisions had been entirely consumed.

The yellowish fecal material was deposited at the base of the cell in a pile of 1-mm-wide flattened pellets (Fig. 6).

Larvae.—The naked larvae rested on their dorsal surface, supported by their large, dorsolateral lobes (Figs. 7, 8). Often, fecal material was stuck to the larvae between these lobes. The larvae were creamy-white, rigid, and averaged 12 mm in length. Overwintering took place in the prepupal stage.

Nest Associates

Two nests with a total of 5 cells were parasitized by an undescribed species of *Nomada,* subgenus *Pachynomada.* This species was described recently in an as yet unpublished revision of *Pachynomada* by A. Moalif,



Figs. 1, 2, 4–11. Fig. 1. Entrance to nest of *Andrena*. Fig. 2. Nest entrance of *Andrena* showing plug of soil used to close the nest during the afternoon and night. Fig. 4. Cell of *Andrena* illustrating wax lining at the base. Fig. 5. Cell cap of *Andrena*. Note the spinal pattern. Fig. 6. Mat of fecal material deposited at base of *Andrena* cell. Fig. 7. Cell of *Andrena* that contains the overwintering prepupal larva. Fig. 8. Lateral view of prepupal *Andrena* larva. Note the large projection on larvae. Fig. 9. Prepupal larva of *Nomada* n. sp. in *Andrena* cell. Fig. 10. Ventral view of prepupae of *Nomada* n. sp. Fig. 11. Fecal pellets of *Nomada* n. sp. in *Andrena* cell.

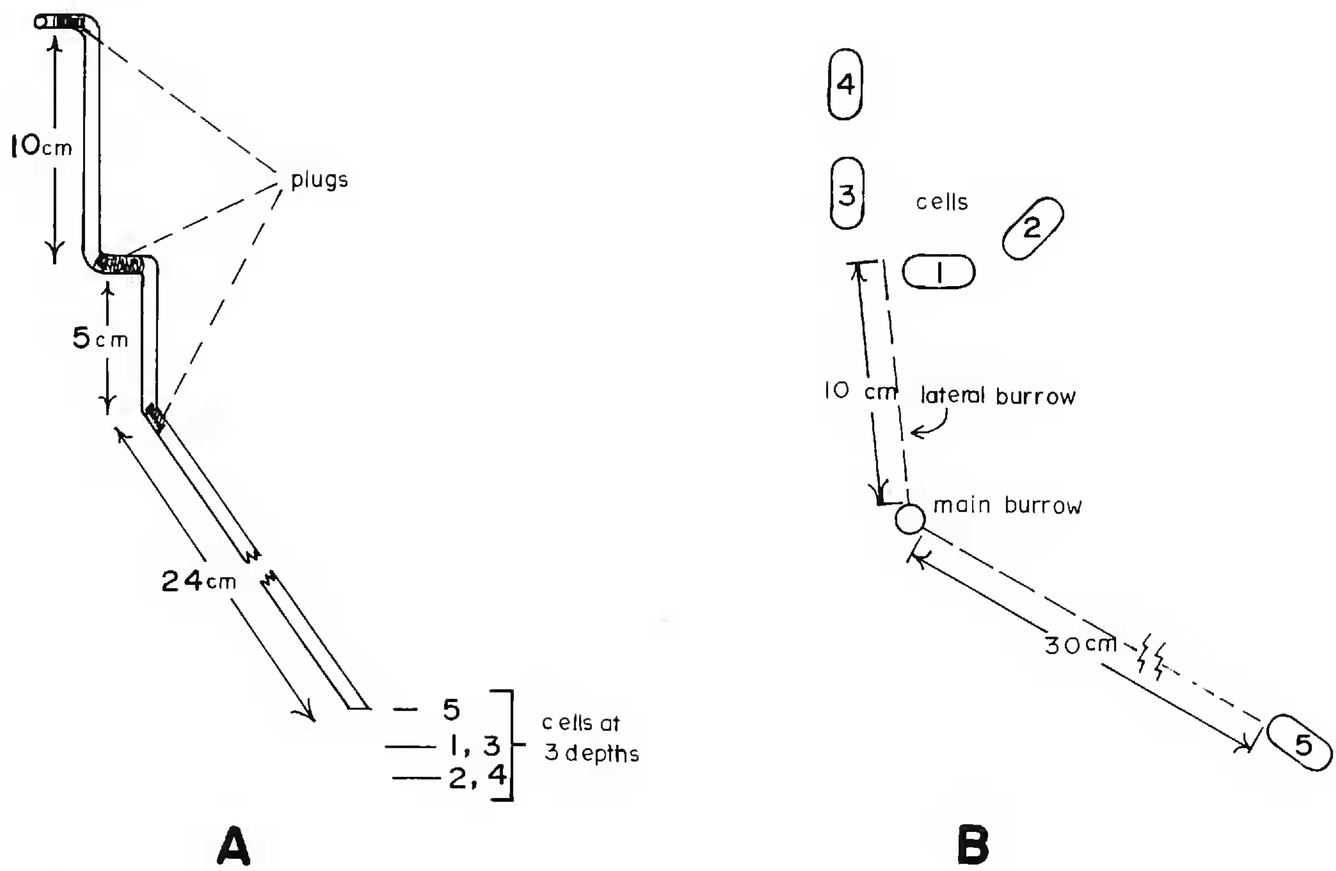


Fig. 3. Diagram of *Andrena* nest—(A) cross section illustrating slope of burrow and cells, (B) arrangement of lateral burrows and cells.

Dept. of Biology, Utah State University. The parasitic larvae were easily distinguished by their yellow color and rigid form (Figs. 9, 10). Their fecal pellets were short (2 mm wide and 0.7 mm long) and scattered about the cell walls (Fig. 11). Egg placement was not determined, but some cells had a shallow puncture at the base or on the side of the cell. Linsley and MacSwain (1955) described similar shallow holes as being made for egg deposition by another species, *Nomada* (*Gnathias*) *opacella* Timberlake. Two other cells contained hyphal mats of an unknown fungus in the Ascophaeraceae (det. N. Youssef, Utah State University). Most of the fecal pellets were broken down and encased by these hyphae. This fungus was also seen growing in a cell occupied by a healthy larva of *Nomada*.

Adults

Seasonal occurrence.—Since sunflowers were planted three times during the spring, bloom was available from July to September. Counts of all bees on flower heads were made by 0900, 1100, and 1300 hours every Monday, Wednesday, and Friday. Sunflowers began to bloom on July 25, and the first *Andrena* were observed on July 27. Both sexes were abundant but their ratio was not recorded. The seasonal appearance of *Andrena helianthi* indicates that it has but one generation/year. The graph of their seasonal

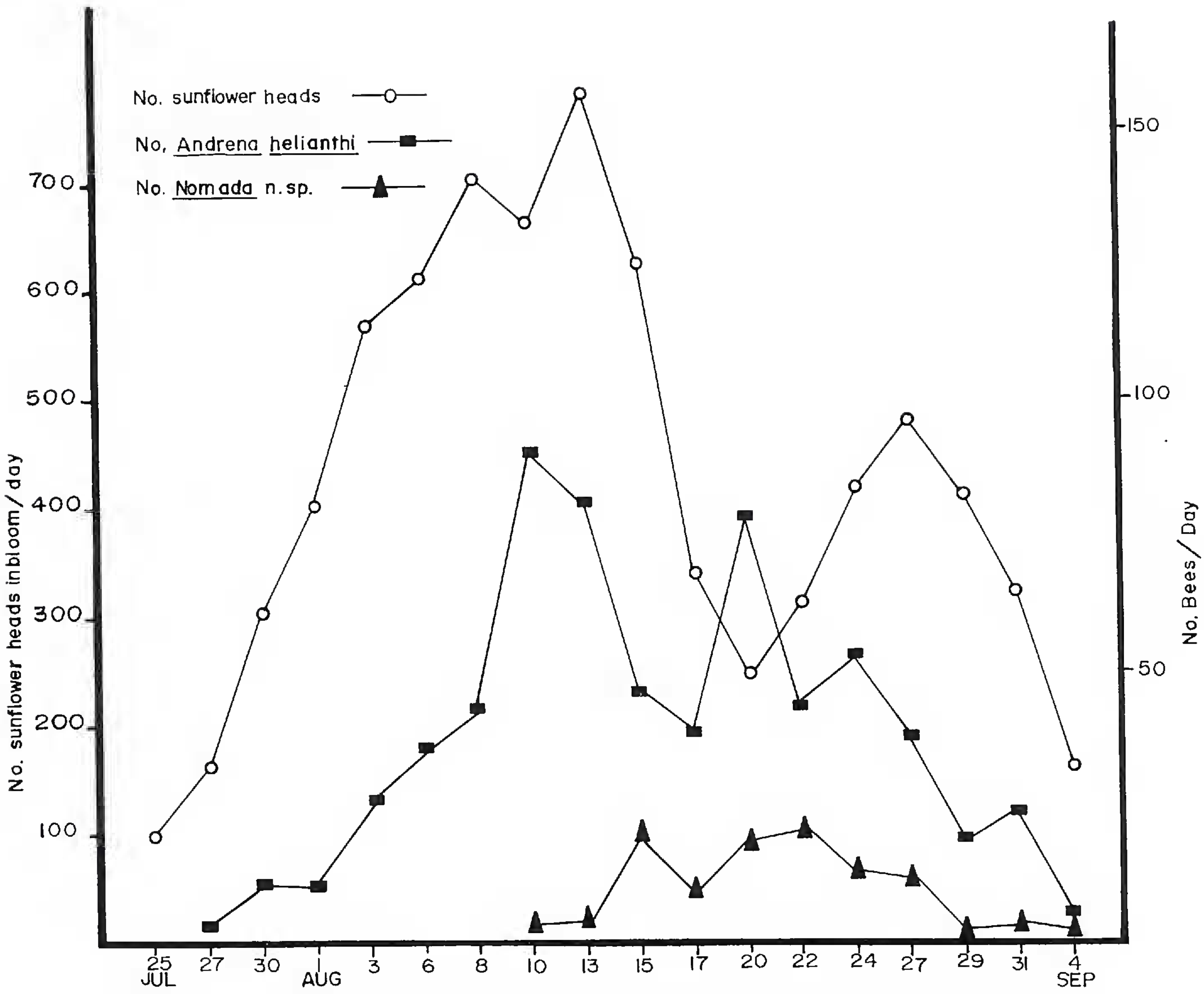


Fig. 12. Seasonal pattern of sunflower bloom and seasonal abundance of *Andrena helianthi* and *Nomada* n. sp.

appearance appears bimodal, but these peaks are influenced by the blooming pattern of the three plantings (Fig. 12).

Daily activity.—Andrena. During the first part of the season more adults were observed at the 0900 hour count than during the 1100 and 1300 hour periods combined. This pattern changed in late August, when the 0900 and 1100 hour counts were nearly the same. Only 9.8% of all *Andrena* counted were recorded at 1300 hours. Their absence from the flowers and the closure of the nests during the afternoon indicates that females remain in the burrows at this time of day. Males were not seen clustering on the flower heads, and it is not known where they spend the night.

Nomada.—These cuckoo bees did not appear until late in the season (August 10), but they were observed on all subsequent days during which counts were made (Fig. 12). More *Nomada* were observed on the flower heads at 1300 hours (55) than at 0900 (38) or 1100 hours (23). Apparently the cuckoo bees enter the host nests in the morning when the *Andrena* are out foraging and forage on the sunflowers in the afternoon when the host bees are working in their nests.

Provisioning.—Andrena helianthi foraged on and provisioned its nests exclusively with sunflower pollen. The maximum pollen load carried by females was estimated (by washing the pollen grains from the body hairs and counting them with a hemocytometer) at 250,000 grains.

Discussion

Andrena accepta, the only other species of *Callandrena* whose biology is known, has communal nests (Rozen, 1973). Although burrows of *A. helianthi* were not monitored during the nesting season, the number of cells/nest indicates that the females were solitary in their nesting behavior.

Acknowledgments

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Literature Cited

Hicks, C. H. 1926. Nesting habits and parasites of certain bees of Boulder County, Colorado. Univ. Studies, Series A, 15:217–252.

Hurd, P. D., Jr. 1979. Apoidea. Pp. 1741–2209 *in* K. V. Krombein, P. D. Hurd, Jr., D. R. Smith, and B. D. Burks, Catalog of Hymenoptera in America North of Mexico, Vol. 2. Smithsonian Institution Press, Washington, D.C.

Linsley, E. G., and J. W. MacSwain. 1955. The habits of *Nomada opacella* Timberlake with notes on other species. Wasmann J. Biol., 13:253–276.

Rozen, J. G. 1973. Biological notes on the bee *Andrena accepta* Viereck. J. N.Y. Entomol. Soc., 81:54–61.